

# DAQ and Thresholds

Leon Mualem

University of Minnesota

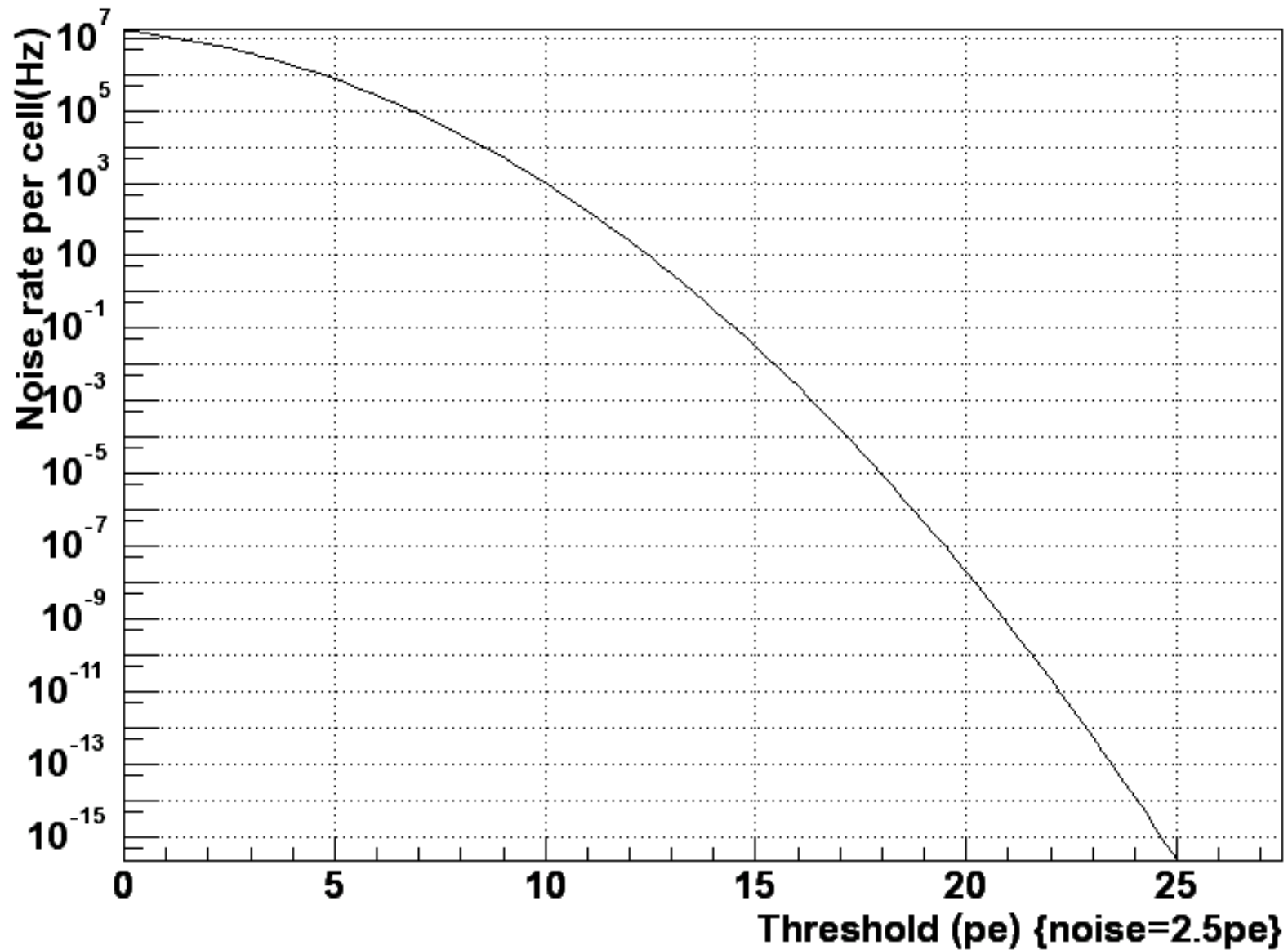
# Data Rates

- Driven by Cosmic Ray induced Muons
- $\sim 250\text{kHz}$ , leading to  $\sim 400\text{Hz/channel}$  or  $12\text{kHz/module}$  rate
  - $120\text{kB/module/s}$
  - But  $23,808 * 120\text{kB/s} = \sim 3\text{GB/s}$

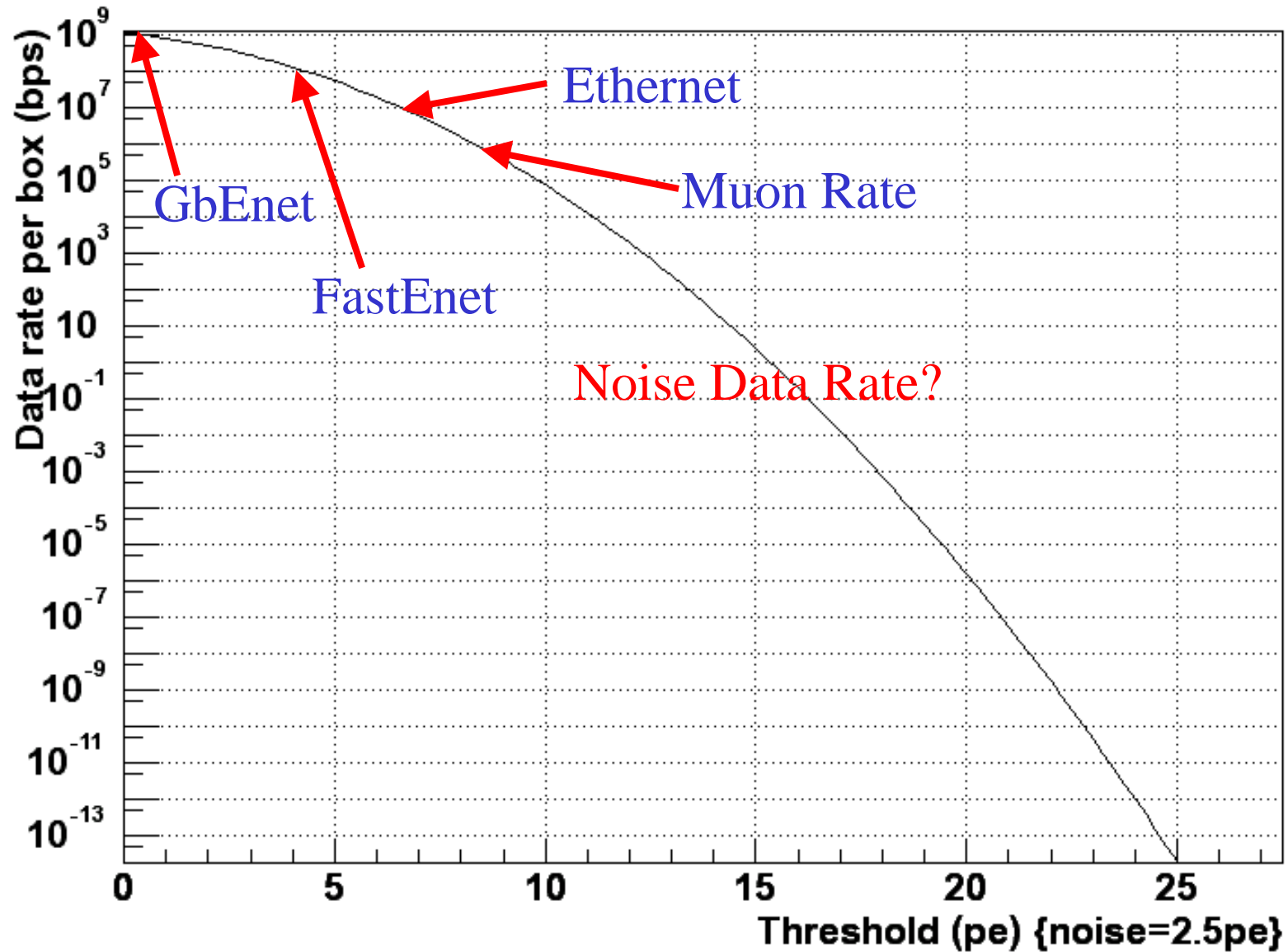
# Noise Data Rates

- Determined by noise level and threshold
- Noise ~Gaussian  $\sigma=2.5\text{pe}$
- Data output 10 bytes/hit above threshold
- $10^6$  time slices per second
- Maximum data rate—  
 $32\text{chan} * 10\text{bytes} * 8\text{bits/byte} * 10^6 = 2.5\text{Gbps/box}$
- $23,808 * 2.5\text{Gbps} = \sim 60\text{TB/s}$

# Noise Rate per box vs. Threshold



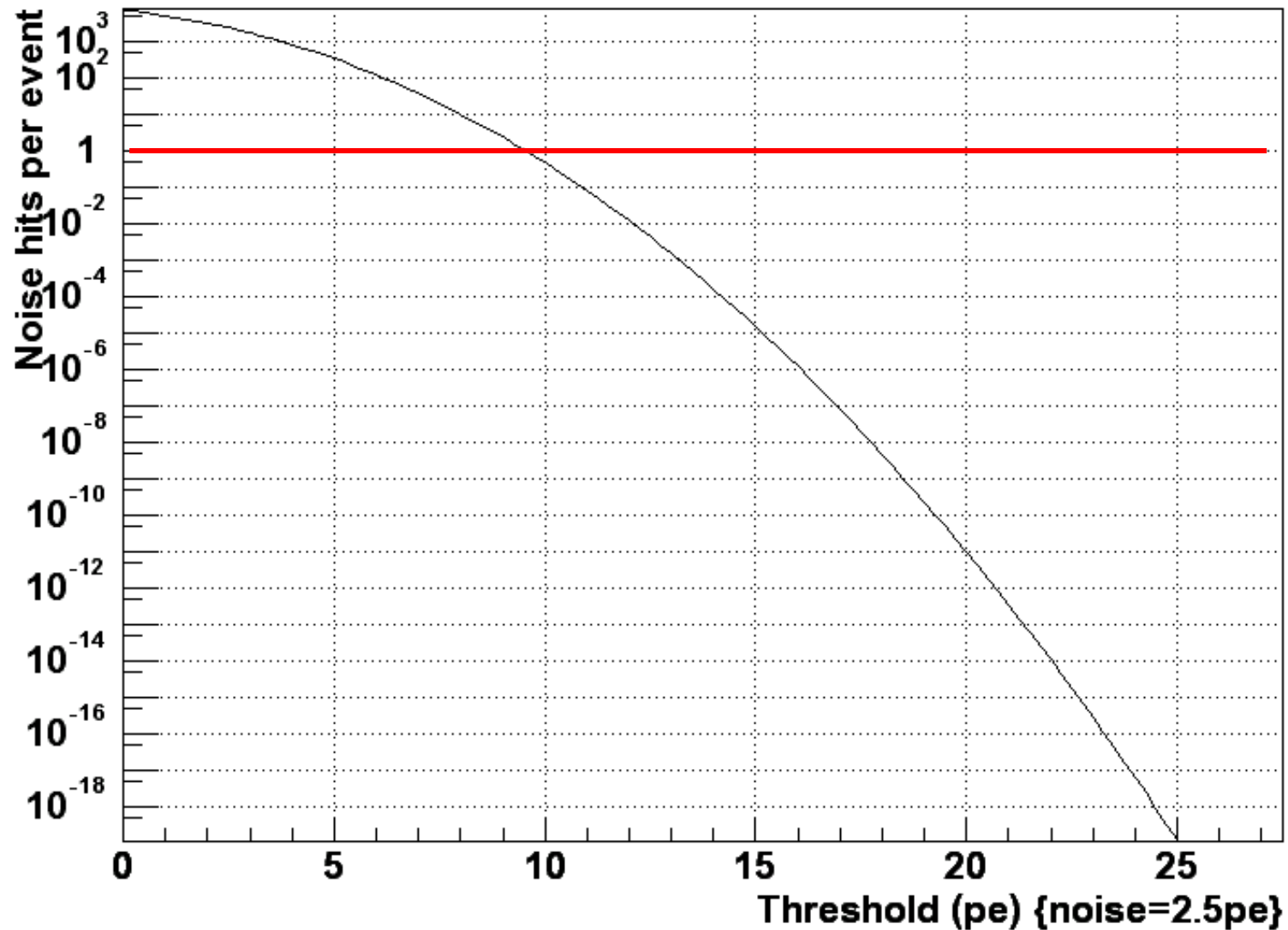
# Noise Data Rate vs. Threshold



# Noise in Events

- Largest events are quasielastic  $\nu_{\mu}cc$  events.
- Assume  $\sim 2m$  in each view, 50 strips
- $\sim 100$  planes/GeV,  $\sim 300$  planes long
- $\sim 15000$  strips in an event
- Use the noise rate and the number of strips to calculate the noise contamination of an event.
- Contamination of events  $\sim 10$  noise hits per event at 8pe,  $\sim 1$  hit/event at 9pe.
  - 10 hits at 8pe  $\approx < 30MeV$
- DAQ rate limit (ethernet) limits threshold to  $\sim 8pe$  minimum

# Noise per event vs. Threshold



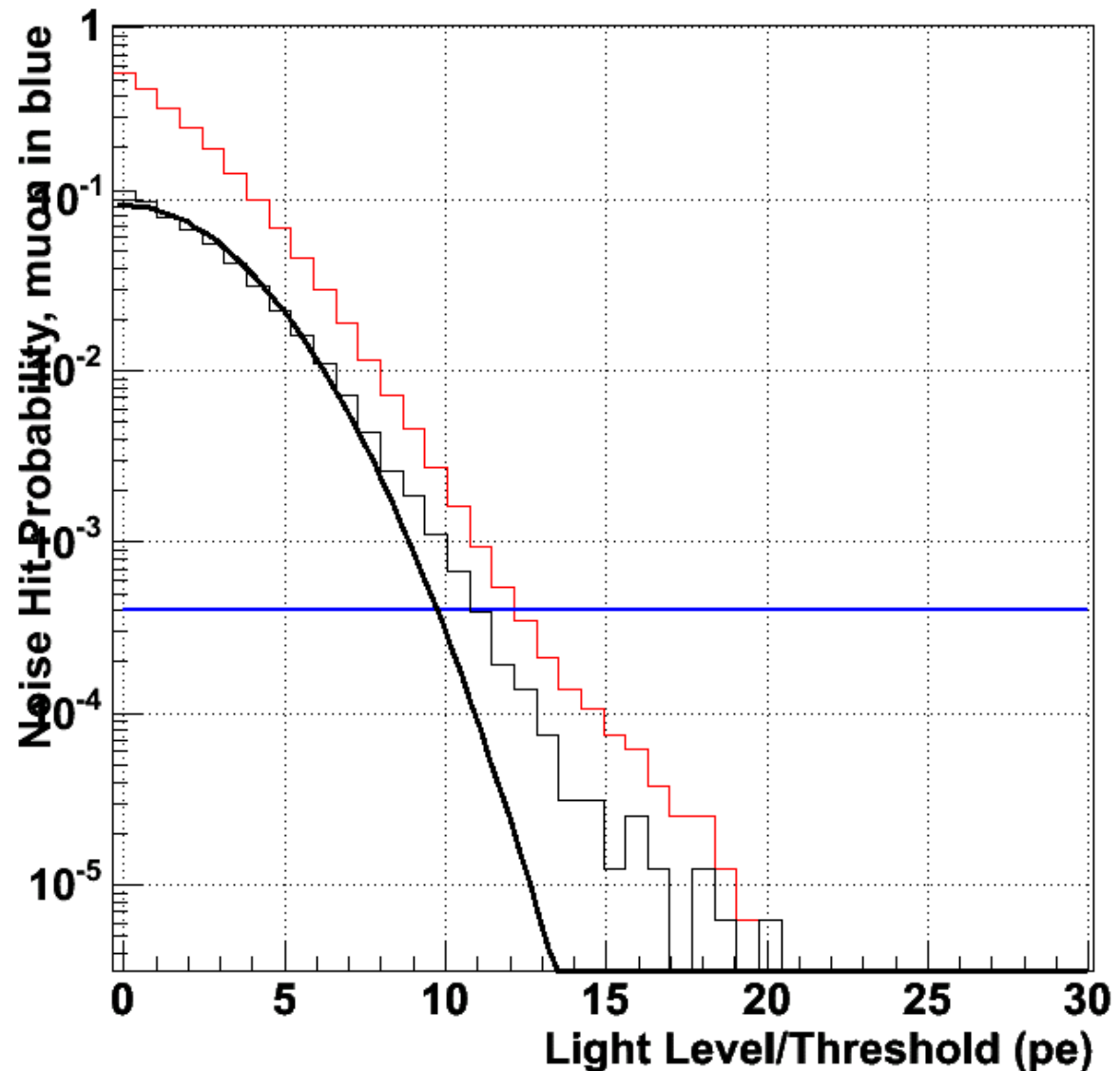
## But Wait, There's More

- There is a non-Gaussian tail associated with the APD system.
- Assuming that this noise will be present, it will limit the threshold.



# Threshold limits in reality (M=100)

At gain of 100  
the threshold is  
~15pe to keep  
rate limited to  
 $\frac{1}{4}$  of muon rate



# Conclusions

- Noise is not entirely described by a Gaussian.
- The non-Gaussian tail limits the threshold in reality to about 15pe for a noise rate 4X less than the muon rate.
- Threshold does not need to be high to limit noise in events, solely to hold down rate of writing noise to tape